Washington State
Department of Transportation

A WHITE PAPER

On:

"Metrication At WSDOT:
Where Have We Been,
Where Are We Going?"

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I. PURPOSE

To explain the status of metrication in WSDOT, outline reasons for various decisions and contemplate the future course of action.

II. BACKGROUND

A. A Chronological History Of U.S. Metric Conversion Policy
(A more detailed explanation of the following bullets is contained in Appendix A.)

- The Metric Conversion Act of 1975 - The Metric Conversion Act of 1975 declared a national policy to coordinate and plan the increasing use of the metric system.

- Amendments to the Metric Conversion Act (1988) - In August 1988, as part of the Omnibus Trade and Competitiveness Act, the Congress amended the Metric Conversion Act of 1975.

- Executive Order 12770 (1991) - required federal departments and agencies to formulate a metric transition plan by November 30, 1991 and an assessment of agency progress and problems together with recommendations for implementing metric conversion by June 30, 1992

- **FHWA Metric Conversion Plan (October 31, 1991)** - mandated that all Federal and Federal-aid construction contracts awarded after September 30, 1996 must be in metric units.

- GAO Report ("METRIC CONVERSION" (January 1994) - the report concluded that with the exception of the Department of Education, federal preparations for metric conversion were well underway.

- **NHS Designation Act (November 1995)** - National Highway System legislation included an amendment that waived the FHWA deadline of September 30, 1996 until September 30, 2000

- "Duncan" Bill (H.R. 3517 - July 1996) - Rep. Duncan (TN) introduced a bill to amend the NHS Designation Act which would remove the September 30, 2000 implementation date.

- "Bachus" Bill (H.R. 813 - February 1997) - Rep. Bachus (AL) introduced same legislation as Duncan. No activity on this bill since then.

B. A Chronological History Of WSDOT Metric Conversion Policy

- Metrication Task Force Appointed (August 1992) - David Thompson, appointed chair of the Metrication Task Force

- Metrication Conversion Process Policy (September 1992) - A draft policy calling for WSDOT metric implementation by July 1, 1994. The policy was never approved.

- Metric Implementation Group (MIG) Formed (September 1993) - An interdisciplinary team of as many as 30 was formed to foster communication among groups responsible for metric implementation.

- CRSI Removes Metric Rebar Endorsement (June 1995) - The Concrete Reinforcing Steel Institute (CRSI) removes endorsement of "hard"[1] converted rebar standard ASTM A615M in favor of "soft"[2] conversion.

- FHWA Approved "Exception" Projects (October 1995) - FHWA approves exceptions of 32 projects from the September 30, 1996 mandate. based on case by case descriptions.

- Commission Address (December 1995) - Skip Burch advises that metric implementation continue toward the September 30, 1996 deadline

- "Housekeeping" RCW Legislation Introduced (January 1996) - WSDOT proposes legislation to add clarifying metric measures to the appropriate statutes so the Department will be in compliance with state and federal laws. The legislation did not pass.

- AASHTO State DOT Survey (April 1996) - reports that 42 states plan to continue metrication toward the September 30, 1996 deadline

- WQI Metrication Team (July 1996) - The Washington Quality Initiative establishes a metrication team for the purpose of "determining a consistent approach to metrication for all state and municipal transportation agencies".

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[1] "Hard" conversion means to convert to metric units and then round to rational even numbers.

[2] "Soft" conversion means converting English units to their direct metric mathematical equivalent.

- English Projects Increase (March 1997) - WSDOT has approximately 75 projects planned for advertisement in English.[3]

- WQI Metrication Team Disbands (April 1997) - Consensus opinion is that the contractor industry can cope with projects let with either unit.

- As of September 1997, dual unit (usually metric with English in parenthesis) versions of the following manuals have been produced:
  - Construction Manual
  - Local Agency Guidelines
  - Highway Design Manual
  - Bridge Design Manual
  - Highway Runoff Manual
  - Highway Surveying Manual
  - Hydraulics Manual
  - Materials Manual
  - Plans Preparation Manual
  - Traffic Manual

  In addition, there are separate metric and English versions of the Standard Specifications and the Standard Plans manuals.

III. DISCUSSION

A. Reasons For Metrication Decisions.

From the point that the FHWA mandated metric conversion, the WSDOT acknowledged compliance. There was no question about complying, only how to comply. The Policy Team and the MIG both recommended courses of action with the endorsement of executive management. Some of the major decisions were:

[3] Some of the reasons for this increase include ease of building "retrofit" type of projects. For example, modifications to the Evergreen Point Bridge were required and naturally all the as-builts were in English. It was much easier to design and build this retrofit using English and until the year 2000 deadline is near, the decision was to use English. The same decision was made for some other projects involving municipalities still using English, or the work we did for municipalities required English. Some other emergency type projects, like slide repairs, were completed with English.

1. Proceed With Metrication

   Once the MIG was formed, it was decided that dual unit implementation was not practical. This was based on Canadian and other countries experiences and because plan sheets would be much too crowded and unreadable (and likely confusing) by showing every dimension in dual units. As the MIG proceeded defining implementation activities, it became clear that right-of-way plans were a different circumstance. MIG decided that dual units would be used on right-of-way plans because of their use in working with property owners. The general direction was to convert all manuals to metric only and design all projects (not just federal-aid projects) using the metric system.

   MIG commissioned a sub-committee to develop metric standards and with the help and review of many stakeholders, developed a workable set of metric standards for use in designing metric projects. Major decisions included the format of stationing, size and scale of plan sheets and a cross-reference scheme (computer program) to existing mile posts (there was no intention to install kilometer posts until the signing issue was resolved). MIG decided projects would be designed and constructed using metric units, but signage would remain in English units.

2. Must Have Exception Projects

   As implementation activities continued, MIG recognized that as our program is developed, it would not be possible to simply switch advertising all of our projects from English to metric instantaneously on October 1, 1996. Some English-designed projects that were to be advertised prior to October 1, 1996 may be delayed while others to be advertised after that date and had already large sunk costs, would incur significantly large additional costs to convert to metric. The FHWA approved all of our petitioned exceptions on a case-by-case basis. It was obvious that WSDOT would have to maintain the English-version Standard Specifications and Standard Plans manuals for a period of time after the deadline.

   MIG also decided it would be appropriate to advertise several pilot metric projects prior to the FHWA deadline. It would give WSDOT and the contractors and idea of the training and construction problems to be encountered. The first metric job was let in the Northwest region in January 1996. Experiences of WSDOT and the contractor were favorable, with no major problems identified.

3. MIG Concurs With CRSI

MIG debated the merits of concurring with CRSI lobbying efforts to use soft-converted rebar versus the hard metric standard. After concluding that most neighboring states would concur with the CRSI recommendation, the MIG accepted the recommendation, principally because of added costs for our projects if we adhered to the hard coding standard.

4. What To Do About Change In Deadline To October 1, 2000.

When Congress changed the metric deadline to October 1, 2000 MIG members analyzed options and recommended proceeding at "full speed ahead" as if the original deadline still existed. The main reasons for this action were: everything was practically in place to design in metric, most projects were already started in metric, to restart in English only to have to shortly enough return to metric to meet the 2000 deadline seemed counterproductive and general consensus of surrounding states was to continue metric design.

Executive management concurred with this direction and based discussion with the Commission on the lag time necessary for project design prior to advertisement.

B. *Why Dual Unit Manuals?*

Although most local agencies acknowledged following WSDOT lead to metric implementation, the deferral to the year 2000 caused most local agencies to "wait and see" what would happen to the federal metric commitment as time passed. In recognition that local agencies would continue English design WSDOT management revised an earlier decision to produce metric only manuals and directed agency managers to redevelop their manuals and procedures to support dual units. This had little impact on most manuals and procedures as incorporation of dual units was relatively easy. There were two exceptions to this - the Standard Specifications manual and the Standard Plans manual. Both of these manuals require separate English and metric versions, for legal purposes, and to maintain compatibility with the General Special Provisions (GSP's). Thus, each manual required effort to update their older English versions and make them compatible with the metric versions. Each manual will require parallel updates when changes are made. Same is true of all the GSP's.

E. *Where Are The Feds In All Of This?*

It's hard to predict what Congress will do, but it is certain that the FHWA is strongly behind the conversion to metric. They have steadfastly maintained their commitment to metric and continued to urge state DOT's to not delay their metrication efforts. AASHTO has strongly supported metrication and has lobbied Congress to defeat any legislation aimed to delay or quash metric implementation.

Its likely the Bachus Bill will not pass this Congress. However, its also likely various Congressional members will lobby or propose delaying or metric-killing legislation in future legislative sessions.

F. *Metric Projects Advertised And Constructed*

As of September 1997, WSDOT has let 185 metric designed projects. In addition, five example metric projects referenced to a FHWA inquiry showed:

- $11.9 M Interchange 4.3% under Engineers Estimate
- $18.9 M Interchange 3% under
- $3.8 M Paver 3% over
- $12.1 M Interchange 17% under
- $1.5 M Paver 28% under

IV. CONCLUSIONS

It is obvious that the WSDOT has made a very successful conversion to the use of the metric system. Manuals, processes, policies, procedures, etc. have been changed that guide the development and construction of metric projects. It can be concluded that:

- The MIG did an excellent job in anticipating and implementing tasks necessary to accomplish the conversion to metric. (MIG now meets only on an "as-needed" basis.) The major outstanding issue is caused by the mix of our commitment to metric and the concomitant resolve of local government to use English - at least until October 1, 2000. This creates problems when we develop projects that involve local agency work. For example, local agencies want English standard pipe for sewer and drain systems. To accommodate this wish, we have to mix metric and English units in the same contract.
- The design, advertisement and construction of metric projects seems to be going smoothly. However, there are some problems because some

products, like certain bolts or other fabricated items are not available in metric. English manufactured products are substituted.

- Contractors would prefer all contracts (WSDOT and local government) to be designed using one measurement system (English) or the other (metric). It's inconvenient to deal with the dual systems, but they seem to be able to accommodate the inconvenience.
- Contractors are successfully bidding and building metric projects. However, metric elements prompt contractor (and subcontractors) to compute conversions from metric to English or vice versa for both bidding and construction (workers don't accept metric as a measuring standard and convert everything to English). This has resulted in errors and in some cases change orders were required to rectify a problem.
- Metric designed projects do not cost more than English designed projects. Early statistics show that metric projects are consistently bid below engineers estimates.
- Fabricators indicate it is easier to transition to metric if "hard conversion" is not mandated. That way when forms wear out or need changing, they can develop new forms for metric dimensioned items. However, inspectors are noticing a loss of either upper or lower tolerances because some of our "soft conversions" have been rounded to the nearest 5 mm. In addition, many of the metric dimensioned steel plates called out in the plans are not available. Steel mills simply do not roll many of the metric dimensioned plates.
- The inconsistent approach to metric implementation by various federal and state agencies has caused difficulties in working with stakeholders. For example, the Washington State Department of Natural Resources requires that WSDOT file certain survey information with them. DNR refuses to accept any metric data and cites the RCW and lack of any direction from their parent federal agency. Similar problems are encountered with private industry (especially utilities) who do not see any metric mandate and do not want to deal with metric units.
- It is the author's opinion that the lack of a clear national effort that includes federal and state government, private industry and the public dooms the successful implementation of the metric system in the United States to a fragmented, piece-meal implementation. WSDOT will continue to have to deal with dual environments with many of our stakeholders for the foreseeable future. The confusion, inconsistencies, possible errors, etc. will continue until the federal government establishes a clear, irrevocable metric implementation deadline and mandates that <u>all</u> work together to achieve that deadline.

IV. **RECOMMENDATIONS**. *So, Should We Do Anything?*

When almost all of WSDOT partners and stakeholders (especially local government) are not converting to metric, one begins to wonder if the WSDOT choice to remain with metric design is prudent. It becomes especially difficult when WSDOT employees have to deal with almost anyone outside of the department. Interactions with them usually require conversions either or both ways. There is a lot of time wasted and the chance to introduce a translation error is compounded.

With that in mind, the following recommendations are offered:

- WSDOT should continue with full metric implementation. The FHWA continues to strongly support the October 1, 2000 mandate. As Skip Burch recommended to the Commission, the timing of the mandate is such that to consider reverting to English design is not appropriate and would probably be counterproductive. This is primarily due to the multi-year timetable design projects. There should be no consideration to allowing a choice of measurement methods. Metric should be the choice, unless English is justified on case-by-case basis. Metric should continue to be our direction until there is an absolute change in the October 1, 2000 mandate.
- WSDOT should continue to use the MIG on an as-needed basis to resolve unanticipated metric conversion problems or decide other metric issues. The most recent MIG meeting (April 1997) addressed and resolved 17 implementation questions raised by Construction and others regarding the manner in which we have implemented our metric processes. MIG should continue to address these type of problems as they arise.
- WSDOT should soften our approach to specification of metric measurements for some items. For example, sometimes certain bolt sizes are not available in the metric dimensions outlined. When this occurs, the contractor should be allowed to substitute English for all bolts as mixing the units of bolt sizes for a construction project is inappropriate. PS&E sheets should show this contingency and appropriate specifications (GSP's) should also allow such substitutions. An effort involving regions and others should be initiated to identify common areas where this repeatedly occurs in contracts and standards tables/specs prepared for OSC by all designers.